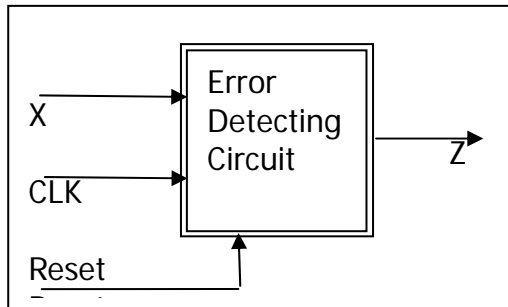


# Mealy Machine

## Example 1

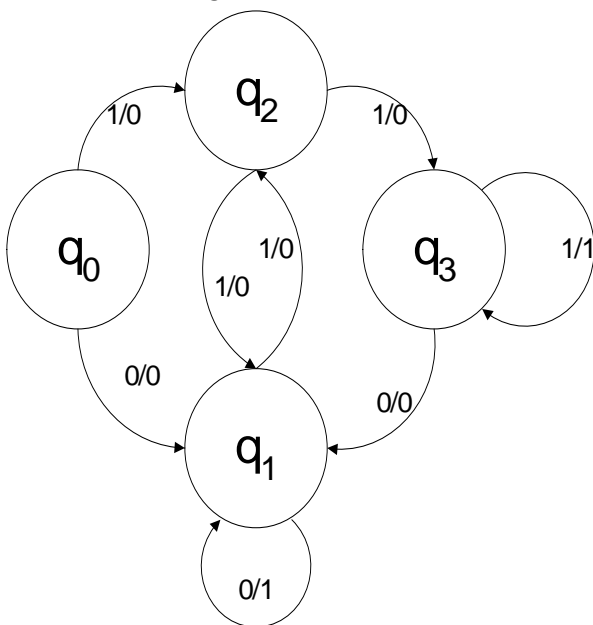
Design an error detector for the following sequential circuit. The circuit has a single input  $x$  and a single output  $z$ . Data arrive serially on  $x$  synchronized with the clock. The output  $z$  (an error) should be "1" whenever two consecutive zeroes or three consecutive ones appear on line  $x$ . Implement the circuit using D, JK, RS and T flip-flops.



Examples of input/output

x	0	0	1	1	1	1	1	0	0	0	1	1	1	0	0	1
z	0	1	0	0	1	1	1	0	1	1	0	0	1	0	1	0
clk	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑

State Diagram:



State assignment

Assign the following state arbitrary:

$q_0=00$

$q_1=01$

$q_2=10$

$q_3=11$

State Transition Table :

Present state	Next state, output			
	x=0		x=1	
$y_1 y_0$	$y_1$	$y_0 / z$	$y_1$	$y_0 / z$
0 0	0	1, 0	1	0, 0
0 1	0	1, 1	1	0, 0
1 0	0	1, 0	1	1, 0
1 1	0	1, 0	1	1, 1

$$\text{error} = z = \bar{y}_1 y_0 \bar{x} + y_1 y_0 x$$

D, JK, T, RS Transition Table:

present → next state	D	J		K	T	R			S		
		store	0			store	0	x	0	0	
0 → 0	0	reset	0	0	0	x	0	store	0	0	0
0 → 1	1	set	1	1	0	x	1	reset	0	0	1
1 → 0	0	invert	1	x	1	1	1	set	0	0	1
1 → 1	1	reset	0	x	0	0	0	reset	1	1	0
		invert	1		1			set	0	0	0
		store	0		0			store	0	0	0
		set	1		0			set	0	0	x

State transition table of the circuit to design

Present state	Next state	
	x=0	x=1
$y_1 y_0$	$y_1 y_0$	$y_1 y_0$
0 0	0 1	1 0
0 1	0 1	1 0
1 0	0 1	1 1
1 1	0 1	1 1

### 1. D-FF implementation

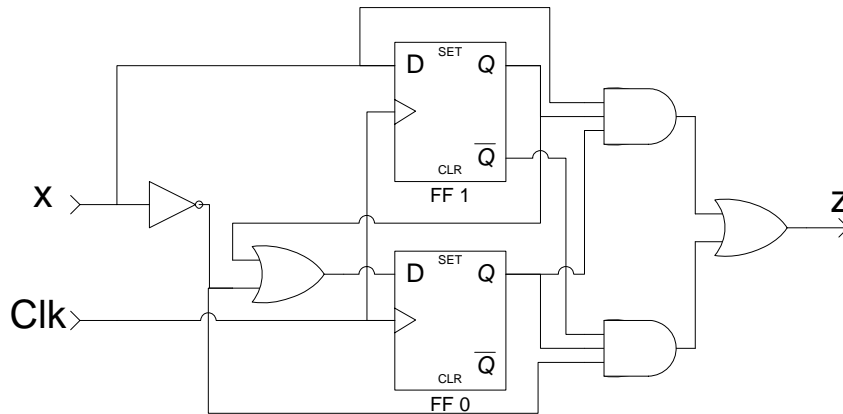
$x$	0	1
$y_1 y_0$	00	0
01	0	1
11	0	1
10	0	1

$$y_1^+ = D_1 = x$$

$x$	0	1
$y_1 y_0$	00	1
01	1	0
11	1	1
10	1	1

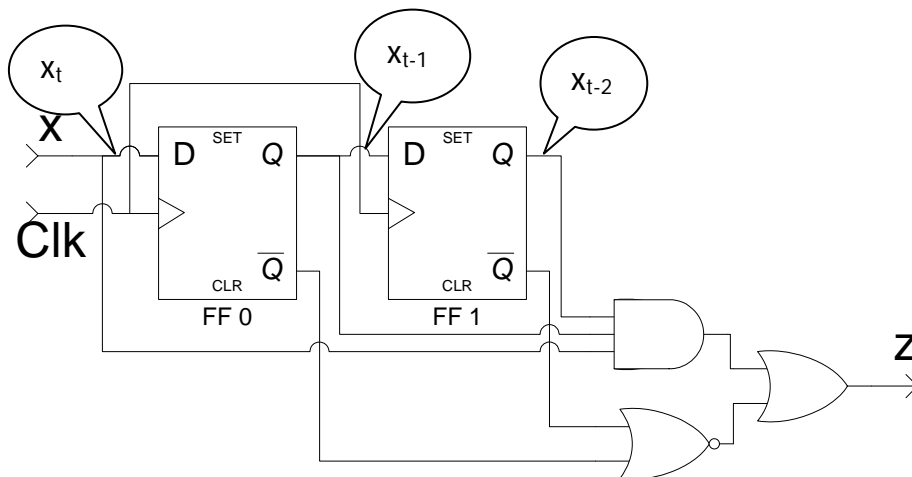
$$y_0^+ = D_0 = \bar{x} + y$$

### Circuit Diagram of implementation with a D-Flip Flop



OR: Directly from Specification:

$X_t$  = Present Input,  $X_{t-1}$  Previous input,  $X_{t-2}$  two clock passed previous input



## 2. JK-implementation

$x \backslash y_1 y_0$	0	1
00	0	1
01	0	1
11	x	x
10	x	x

$$J_{y_1} = x$$

$x \backslash y_1 y_0$	0	1
00	x	x
01	x	x
11	1	0
10	1	0

$$K_{y_1} = \bar{x}$$

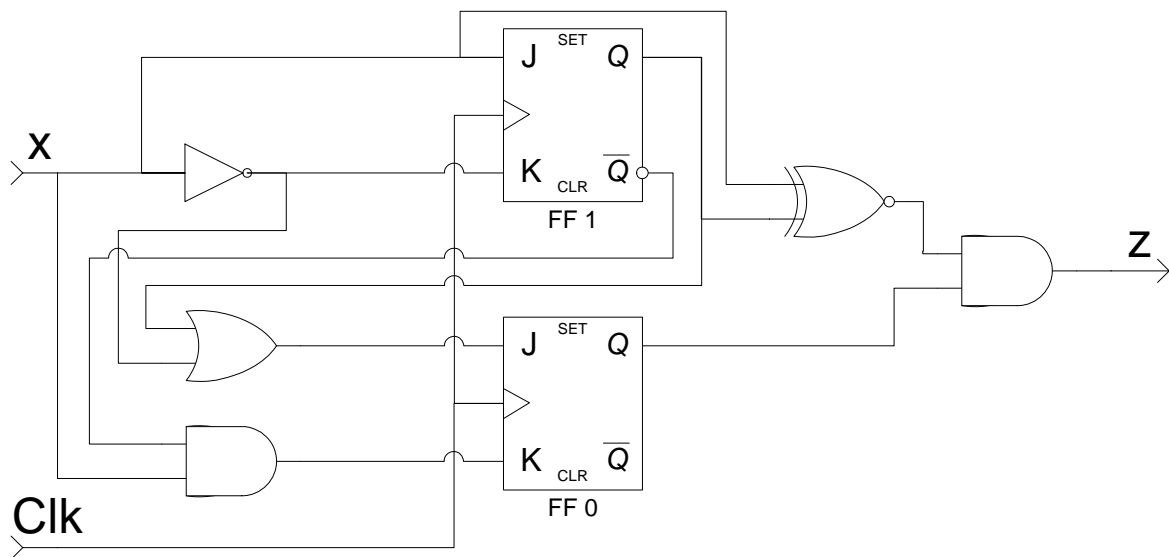
$x \backslash y_1 y_0$	0	1
00	1	0
01	x	x
11	x	x
10	1	1

$$J_{y_0} = \bar{x} + y_1$$

$x \backslash y_1 y_0$	0	1
00	x	x
01	0	1
11	0	0
10	x	x

$$K_{y_0} = x\bar{y}_1$$

### Circuit Implementation



### 3. T-implementation

x \ y <sub>1</sub> y <sub>0</sub>	0	1
00	0	1
01	0	1
11	1	0
10	1	0

$$T_1 = \bar{x}y_1 + x\bar{y}_0$$

x \ y <sub>1</sub> y <sub>0</sub>	0	1
00	1	0
01	0	1
11	0	1
10	1	0

$$T_0 = \bar{x}\bar{y}_0 + xy_0 = x \oplus y_0$$

#### Circuit Implementation

